

# BODY FLUIDS & CIRCULATION

Different grp of animals have evolved diff. methods for this transport

sponges, coelenterate

simple organisms like these circulate water from their surrounding through body cavities to facilitate the cells to exchange these substance.

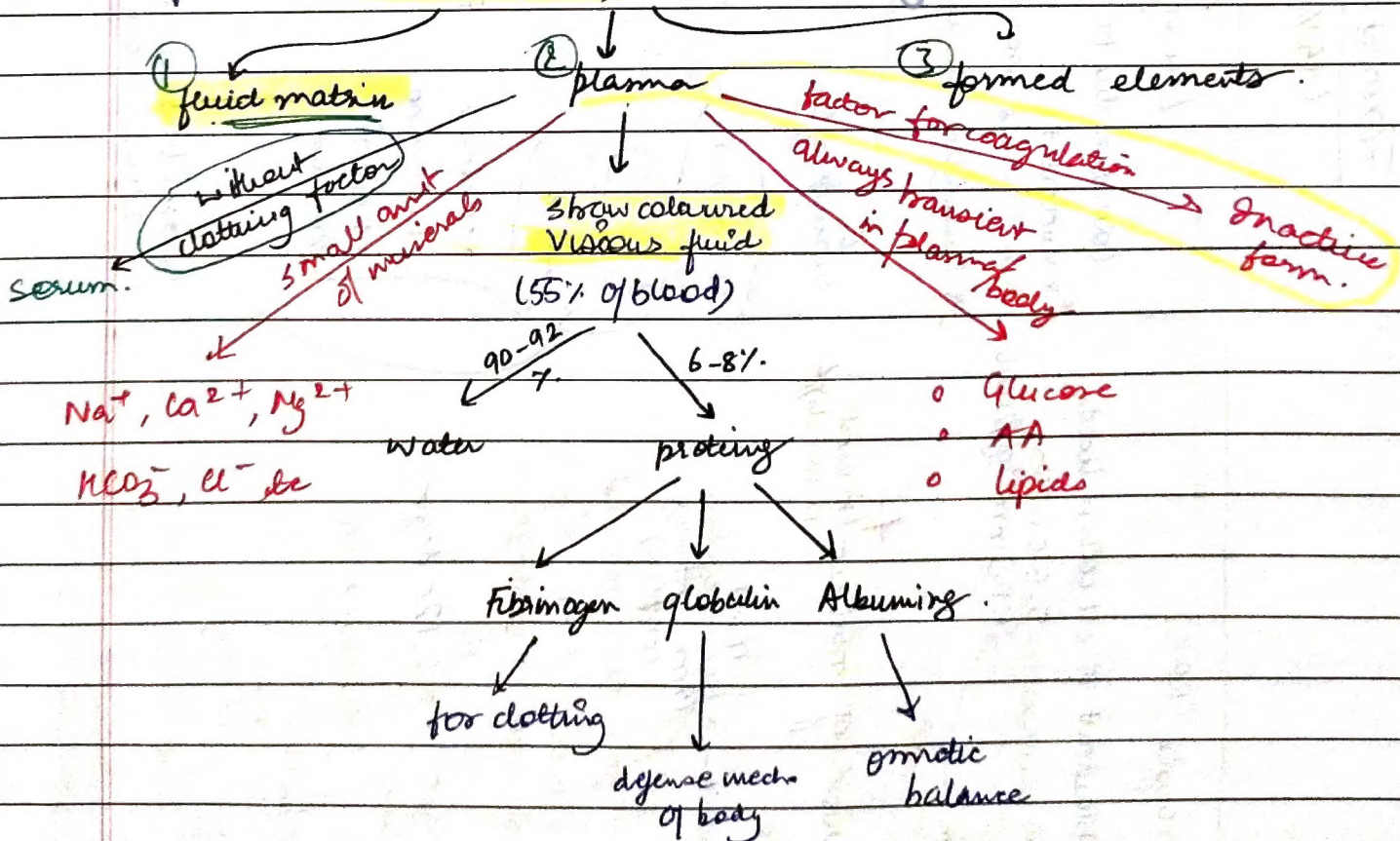
more complex org.

Use special fluids within their body to transport such material

- Blood - most common in higher org. including humans
- Lymph - transport of certain substance

## Blood.

(special connective tissue)





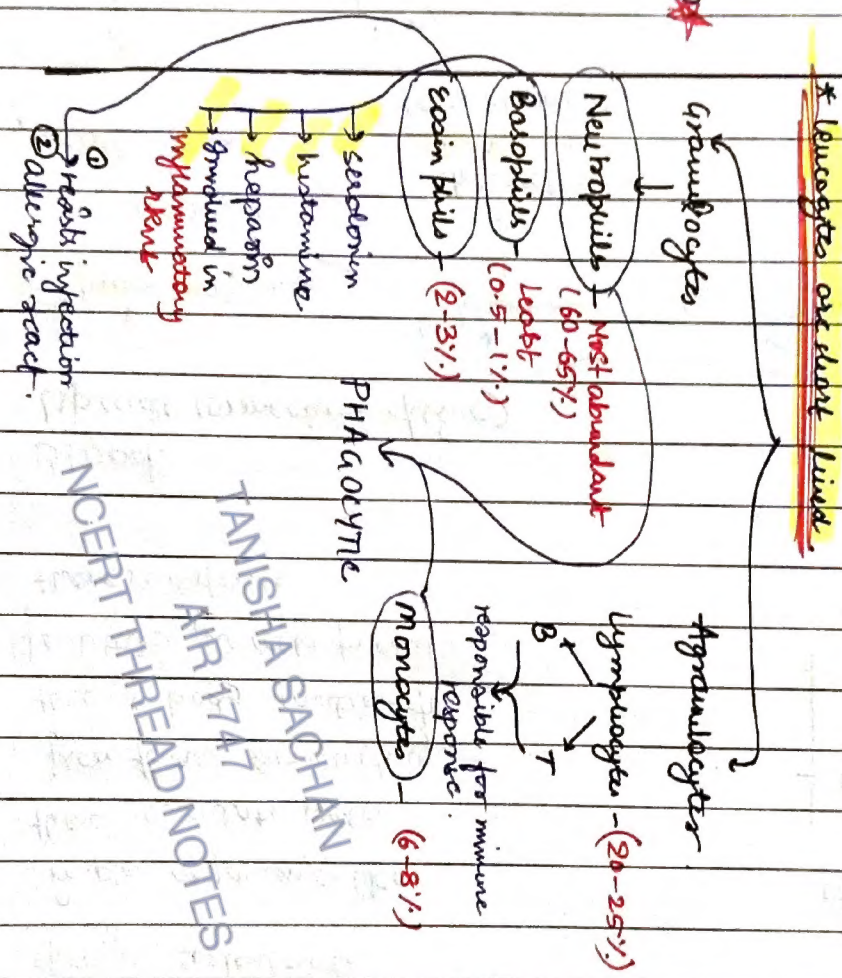
# Formed Elements (15% of our blood)

## Erythrocytes (RBC)

Most abundant of all cells in blood.  
 A healthy adult man - 5-5.5 million RBC mm<sup>-3</sup> of blood.  
 Formed in red bone marrow.  
 \* RBC is devoid of nucleus (in most mammals).  
 \* Biconcave.  
 RBC → have → haemoglobin (from clothing & complex).  
 12-15 gm in 100 ml of blood.  
 \* These molecules play a significant role in transport of resp. gases.  
 RBC, average life : 120 days span.  
 ↓ destroyed in spleen (graveyard of RBC).

## Leucocytes (WBC)

Coloured due to lack of haemoglobin.  
 \* Nucleated.  
 Abundance : 6000 - 8000 mm<sup>-3</sup> of blood.  
 \* Leucocytes are short lived.



## Platelets (Thrombocytes)

Cell fragments.  
 Abundance : 1,50,000 - 3,50,000 platelets mm<sup>-3</sup>.  
 Special cells in bone marrow.  
 (myocytes)

Release variety of subst. involved in coagulation.  
 Reducing in their number can lead to clotting disorder which leads to even loss of blood from the body.



# CIRCULATORY SYSTEM

## LYMPH (TISSUE FLUID)

→ Lymph almost similar to blood except for protein content & the formed elements.

(Blood inside)  
Tissue → Capillaries → comes out → **TISSUE FLUID / INTERSTITIAL FLUID**  
① water  
② small water soluble subst.

Same mineral distribution as plasma.

Funct: Exchange of nutrients, gases  
b/w blood  $\rightleftharpoons$  cells occur  
through this fluid.

In the spaces b/w cells  
of tissues leaving

1) large proteins  
2) most of the formed elements  
left inside B.V.

→ **LYMPHATIC SYSTEM:** Collects this fluid  
& drains it back to major veins

Imp. carrier  
for nutrients,  
hormones, etc

Fluid inside  
Lymph

1) colourless fluid  
2) specialised lymphocyte

→ immune response  
of body.

\* Fate  $\xrightarrow{\text{absorbed through}}$  lymph in lacteals (present in intestinal villi).

COAGULATION OF BLOOD →  $Ca^{2+}$  plays a major role in clotting.

Blood → coagulates or clot  $\xrightarrow{\text{in response to}}$  trauma / injury

↓ prevents

excessive loss of blood from body.

Involves a number  
of factors present in  
plasma in inactive  
state

Dark Reddish Brown scum → at the site of cut / injury

Clt & Coagulum

formed by  
series of linked  
enzymatic  
steps (cascading  
proc.)

prothrombin  
(in plasma)

thrombokinase  
enzyme complex

thrombin

Fibrinogen (in plasma)

• Injury or trauma  $\xrightarrow{\text{stimulate}}$  platelets

→ certain factors  $\xrightarrow{\text{activate}}$

coagulation  
mech.

• Tissue at the site of injury  $\xrightarrow{\text{release factors}}$

$\xrightarrow{\text{activate}}$

Fibrin

↓  
dead & damaged formed elements  
of blood are trapped.



Blood Groups

## NCERT THREAD NOTES

Blood of human beings differ in certain aspect though it appears similar.

Blood groupings

ABO syst.

Rh system

presence of or absence of two antigen (surface) on RBC.

chemical that induce immune resp.

A B

Similarly, the plasma of diff. individual contains two natural antibodies proteins produced in response to antigens

During blood transfusion, blood of donor & recipient should be matched to avoid severe problem of clumping (destruction of RBC).

Blood Grp	Antigen on RBC	Antibody in plasma	Donor Grp
A	A	anti-B	A, O
B	B	anti-A	B, O
AB	A, B	Nil	AB, A, B, O
O	nil	anti-A, B	O

universal recipients

universal donors

Another antigen → Rh → similar to one present in Rhesus monkey.

present on

Surface of RBC of 80% of humans

absent on RBC surface

Rh +ve

Rh -ve

If Rh -ve exposed to Rh +ve blood

Therefore, Rh grp should also be matched before transfusion.

will form specific antibodies against Rh antigen.

Rh Incompatibility → In this case can be avoided by administering anti-Rh antibodies to mother immediately after delivery of 1st baby.

Rh -ve blood of pregnant mother

with Rh +ve foetus

Rh antigens of foetus do not get exposed to Rh -ve blood of mother in 1st pregnancy. bcz two bloods are separated by placenta.

However at the time of delivery some of Rh +ve blood may come in contact to Rh -ve blood of mother → mother starts producing antibodies against Rh antigens.

subsequent pregnancy.

Rh antibodies from mother can leak into Rh +ve foetus & destroy foetal RBCs.

leads to [severe anaemia & jaundice] → extrablastic foetalia



# HUMAN CIRCULATORY SYSTEM →

Blood vascular system

Muscular chambered heart

A network of closed branching BV & blood (fluids that is circulated)

Heart → Mesodermal

entire heart  
↳ cardiac muscle

- ↳ In thoracic cavity, b/w two lungs, highly tilted towards left.
- ↳ Clenched fist size

walls

double walled memb. bag → Pericardium

↓ enclosing.  
pericardial fluid.

- Inter atrial septum — thin, muscular. → RA } LA
- Inter ventricular septum — thick walled → BV } LV
- Atria } thick fibrous tissue → atrioventricular septum.  
Ventricle

openings

AV valve / tricuspid

cusps / muscular flap — 3  
RA & RV

Mitral / Bicuspid

cusps — 2  
LA & LV

The valves in heart → allows flow of blood — only one dir'n. → from atria to ventricles & from ventricles to pulmonary artery of aorta.

\* Wall of ventricle, thicker than that of atria.

Another mass (AVN) — bundle of nodal fibres — AV bundle  
in lower left corner of right atrium close to (AV opening)

Specialised cardiac musculature → Nodal tissue → distributed in heart

A patch of this tissue in right upper corner of right atrium → (SAN)



AV bundle → passes through  
atrioventricular  
septum.

To emerge  
on top of  
interventricular  
septum.

right bundle

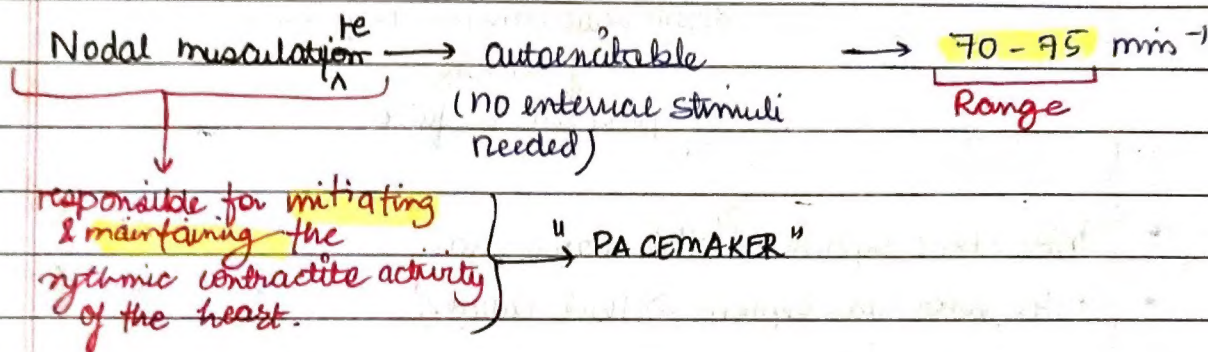
left bundle

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NCERT THREAD NOTES

These branches give rise to minute  
fibres throughout ventricular musculature  
of the respective sides & called  
**Purkinje fibres**



## CIRCULATORY PATHWAYS →

Open

arthrop.  
molluscs

Blood pumped by heart  
↓ (passes through)

large vessels

↓ into  
open space / sinuses

All vertebrates  
& few invertebrates.

Closed

closed network of  
BV present!

(Humans, Cephalopod  
molluscs)

more adv. as the  
flow of fluid can be  
precisely regulated.

All vertebrates → muscular chambered heart.



\* No. of QRS complex  $\rightarrow$  heart beat rate.

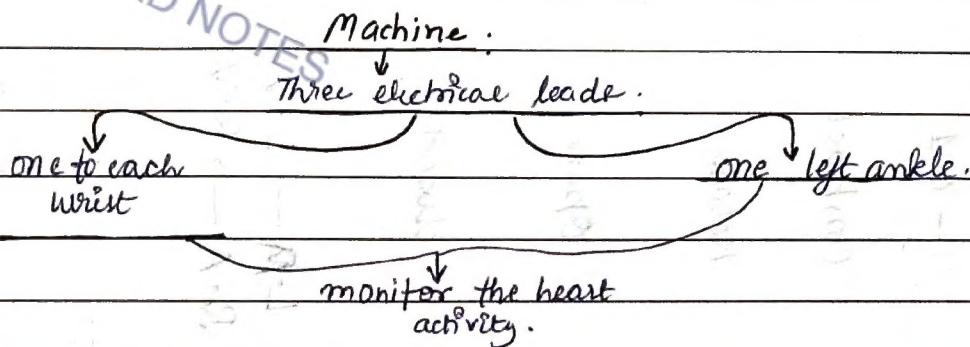
\* ECGs obtained from diff. individuals have roughly same shape for a given lead config., any deviation from this shape indicates possible abnormality or disease, hence of great clinical significance (ECG).

## ELECTROCARDIOGRAPH

"pip... pip... pip... ppppppppp"  $\rightarrow$  cardiac Arrest.

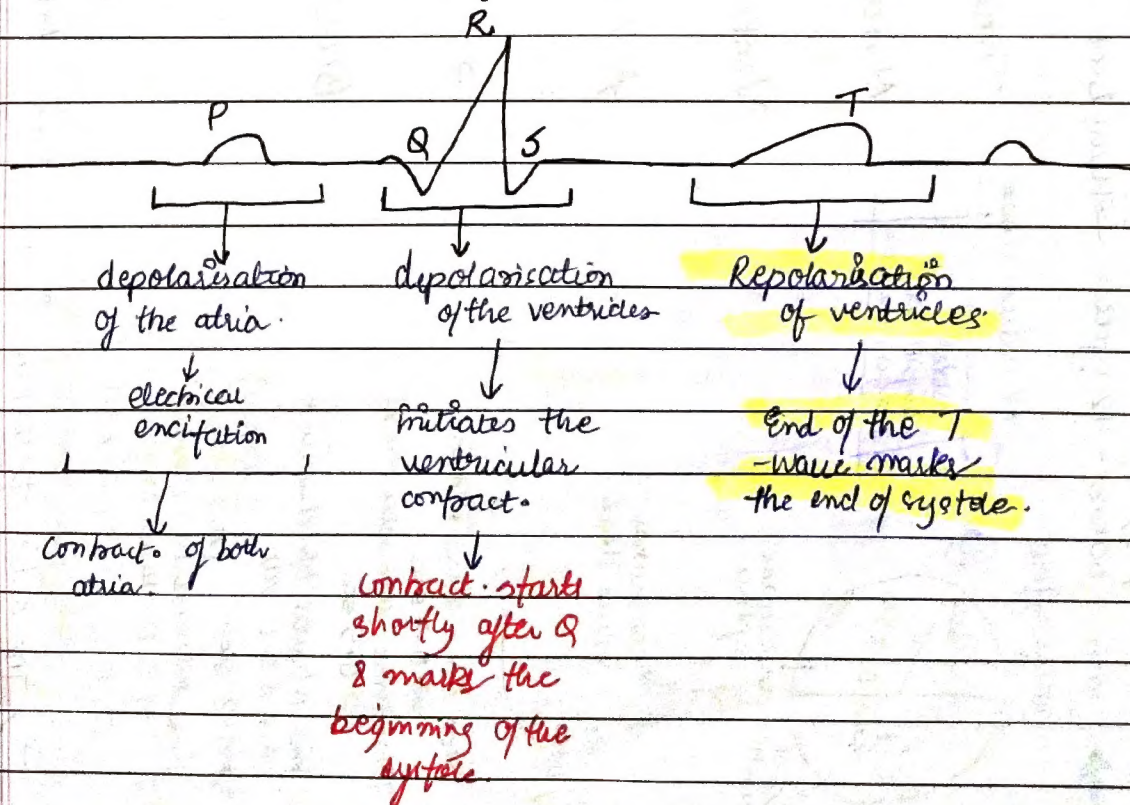
Machine: Electro-cardiograph  $\xrightarrow[\text{obtain}]{\text{to}}$  electrocardiogram

$\rightarrow$  is a graphical repres. of the electrical activity of the heart during cardiac cycle.



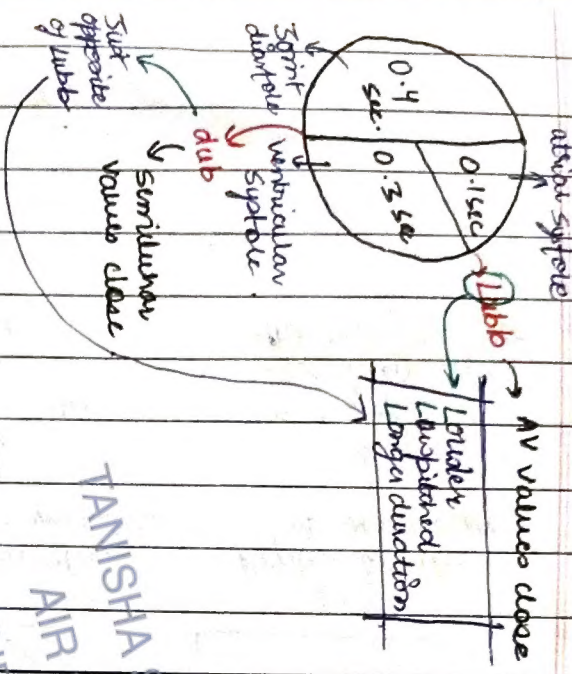
For a detailed evaluation of heart funct.  $\Rightarrow$  multiple leads are attached to the chest region.

Specific electrical activity of the heart.





$\Rightarrow 0.8 \text{ sec / cycle.}$   
 $\Rightarrow 1 \text{ min} = 60 \text{ sec} = 72 \text{ cycles} \rightarrow \text{Heart beat}$



Total time atria relax  $\Rightarrow 0.7 \text{ sec}$   
 Total time ventricles relax  $\Rightarrow 0.5 \text{ sec}$   
 Time interval b/w closure of A.V & S.L valve  $(A.V \rightarrow S.L) \Rightarrow 0.3 \text{ sec.}$   
 Time interval b/w closure of S.L valve & A.V valve  $(S.L \rightarrow A.V) \Rightarrow 0.5 \text{ sec.}$

(\*) The action potential is conducted to the ventricular side by the bundle of His - terminates at the ventricular musculature.

# CARDIAC CYCLE

Time  
 Atria  
 Ventricles  
 A.V valves  
 S.L Valves  
 Blood flow

0 - 0.1	Relax	Open	closed
0.1 - 0.4	Contract	close	open
0.4 - 0.8	Relax	Open	closed

L.V  $\rightarrow$  Aorta  $\rightarrow$  Body  
 R.V  $\rightarrow$  Pulmonary artery  $\rightarrow$  Lungs  
 Pulmonary vein  $\rightarrow$  L.V  
 L.V  $\rightarrow$  70%  
 L.V

AVN & AV

(30% more in atrial systole)  
 In vena cava  $\rightarrow$  vena can a system  
 R.A  $\rightarrow$  30% R.V  
 L.A  $\rightarrow$  70%



# Cardiac Cycle

Ventricular systole  $\xrightarrow{\text{coincides}}$  atrial diastole.

↓ increase ventricular pressure.  
closure of tricuspid & bicuspid valve.

more pressure ↑ → semilunar valves forced open. → circulatory pathways

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ventricular diastole

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↓ decrease ventricular pressure.

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closure of semilunar valves

more pressure ↓ → tricuspid & bicuspid pushed open. → blood now once again move freely in ventricles.

↓  
by the pressure of atria exerted by blood  
↑  
veins

↓  
Joint diastole

\* During a cardiac cycle, each ventricle pumps out approx. 70ml of Blood → Stroke volume.

X  
no. of beats/min

||  
Cardiac output →

5000ml,

↳ by each ventricle

↗ healthy individual



~~① stroke volume~~

The body has  
ability to alter

~~② heart rate~~, & thereby cardiac output

\* Cardiac output : athlete > ordinary man.

\* Cardiac sounds (Lubb, dub) are of clinical diagnostic  
significance.

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Though the heart is auto-excitabile.  
its functions can be moderated.  
by neural & hormonal mechanisms.

## REG. OF CARDIAC ACTIVITY

Normal activities regulated → intrinsically  
(Autoregulated - Myogenic)

↓ by  
specialised muscle  
(nodal tissue)

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Special neural centre  
in medulla oblongata

↓ moderate  
cardiac funct. through  
autonomic NS (ANS)

Sympath.

heart beat rate ↑  
Strength of ventr. contr. ↑  
Cardiac output ↑

Parasympath.

heart beat rate ↓  
Speed of cond. of act. pot. ↓  
Cardiac output ↓

Adrenal medullary Hormon.

Cardiac output ↑

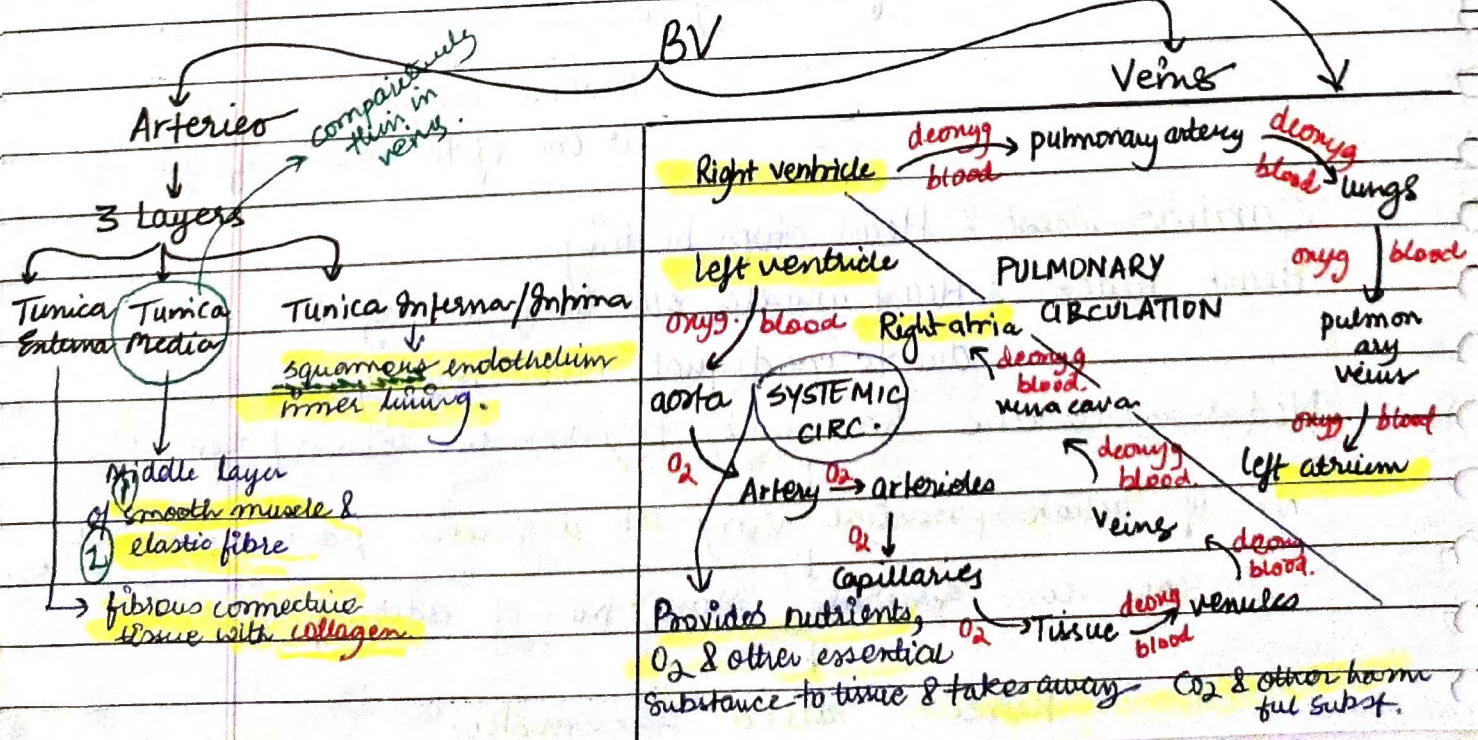
HEPATIC PORTAL SYSTEM

Dig. tract → Unique vax. connect → Liver

The hepatic portal vein carries  
blood from intestine to liver  
before it is delivered to systemic  
circulation.

Coronary system of BV  
For cardiac musculature

## DOUBLE CIRCULATION



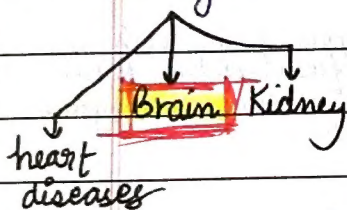


## DISORDERS OF CIRCULATORY SYSTEM

### Hypertension

High Blood pressure.  
 $> (120/80)$  mm of Hg.  
 → diastolic/resting pressure.  
 → normal  
 → Systolic/pumping pressure.

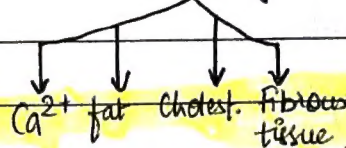
If repeatedly, BP of individual is 140/90 or even higher.



### (CAD) Coronary Artery Disease

#### Atherosclerosis

Affects coronary artery deposits of



Make lumen of arteries narrower.

### Angina

#### Angina pectoris

Acute chest pain

- Enough oxygen not reaching heart muscle

- Can occur in man & woman of any age but more common in middle aged/oldly.

- If after occur due to a condition that affects blood flow.

### Heart failure

State of heart when it is not pumping blood effectively enough to meet the needs of the body. (Congestive Heart failure)

Because congestion in lungs is one of the main symptom.

Cardiac arrest : Heart stops beating

Heart attack : Heart muscle suddenly damaged due to inadequate blood supply.

Nodal musculature has ability to generate action potential

No. of action potential vary at different parts of nodal system

SAN can generate max<sup>m</sup> no. of action potential

Hence called pacemaker.